CLAIMS

What is claimed is:

1. An apparatus to filter a received signal, the apparatus comprising:

at least one delay element to generate a delayed signal by delaying the received signal by a desired delay time; and

a combiner to generate a filtered signal by combining the received signal with the delayed signal;

said delay time of the at least one delay element configured to position a filter null substantially at the frequency of an expected interfering signal.

2. The apparatus of claim 1, further comprising a switch positioned between the at least one delay element and the combiner to selectively couple the delayed signal into the combiner, such that the combiner outputs either the filtered signal or the received signal.

3. The apparatus of claim 2, further comprising a switch control element to control the switch.

4. The apparatus of claim 3, wherein the switch control element comprises a logic circuit to control the switch based on a data rate of the received signal, such that the delayed signal is coupled into the combiner when the data rate is below a defined threshold.

5. The apparatus of claim 3, wherein the switch control element comprises a logic circuit to control the switch based on a spreading factor of the received signal, such that

the delayed signal is coupled into the combiner when the spreading factor is above a defined threshold.

6. The apparatus of claim 3, wherein the switch control element comprises at least one processor to control the switch based on comparing measured interference in the received signal and the filtered signal.

7. The apparatus of claim 6, wherein the at least one processor switches the delayed signal into the combiner if the filtered signal includes less interference than the received signal.

8. The apparatus of claim 2, wherein the switch comprises a digital switch.

9. The apparatus of claim 1, wherein the at least one delay element comprises a digital delay element.

10. The apparatus of claim 9, wherein the received signal is a W-CDMA signal and the expected interfering signal is a GSM signal transmitted at a frequency relatively close to a transmit frequency of the W-CDMA signal, and wherein the delay time is calculated to position the filter null substantially at a baseband offset frequency of the GSM signal relative to the W-CDMA signal.

11. A delay-and-add filter to filter narrowband interference from a relatively wideband received signal, the filter comprising:

a digital delay element to produce a delayed signal at an output by delaying a received signal applied to an input, said digital delay element having a time delay calculated to position a filter null at a desired frequency corresponding to the narrowband interference; and

a combining element to generate a filtered signal by combining the received signal and the delayed signal output from the digital delay element.

12. The delay-and-add filter of claim 11, wherein the digital delay element comprises at least one delay stage that imparts a cumulative delay of N x $1/f_s$, where N is a desired multiple and f_s is a sampling frequency of the received signal.

13. The delay-and-add filter of claim 11, wherein the received signal comprises a baseband W-CDMA signal having a chip rate of approximately 3.84 MHz and a sampling frequency f_s that is four times the chip rate, and wherein the at least one delay stage imparts a cumulative delay of three times $1/f_s$, such that filter nulls are positioned at $f_s/6$, $-f_s/6$, and $f_s/2$.

14. The delay-and-add filter of claim 13, wherein the filter null for the delay time $f_s/6$ is offset relative to the W-CDMA received signal at approximately 2.6 MHz, and wherein the narrowband interference is an interfering GSM signal offset at approximately 2.7 MHz.

15. The delay-and-add filter of claim 11, further comprising a digital switch to selectively couple the delayed signal into the combiner such that in a first state of the

digital switch the combining element outputs the filtered signal, and in a second state of the digital switch the combining element outputs the received signal.

16. The delay-and-add filter of claim 15, further comprising a control element to control the digital switch.

17. The delay-and-add filter of claim 16, wherein the control element comprises at least one processor to control the digital switch based on comparing interference in the received signal with interference in the filtered signal.

18. A W-CDMA receiver comprising:

a receiver front-end to generate a baseband signal from a W-CDMA signal received at a given transmit frequency; and

a delay-and-add filter to generate a filtered signal by applying a frequency null positioned at an expected interference frequency relative to the baseband signal, the delay-and-add filter comprising:

a delay element to generate a delayed signal by imparting a desired time delay to the baseband signal; and

a combiner to generate the filtered signal by combining the baseband signal with the delayed signal.

19. The W-CDMA receiver of claim 18, wherein the delay-and-add filter selectively couples the delayed signal to the combiner such that the combiner outputs either the baseband signal or the filtered signal.

20. The W-CDMA receiver of claim 19, further comprising a processor to control the selective coupling of the delayed signal to the combiner based on at least one characteristic of the baseband signal.

21. The W-CDMA receiver of claim 18, further comprising a digital switch to selectively couple the delayed signal to the combiner.

22. The W-CDMA receiver of claim 21, further comprising at least one processor to control the digital switch.

23. The W-CDMA receiver of claim 22, wherein the at least one processor controls the digital switch based on a spreading factor of the W-CDMA signal.

24. The W-CDMA receiver of claim 22, wherein the at least one processor controls the digital switch based on determining the efficacy of the delay-and-add filter.

25. The W-CDMA receiver of claim 24, wherein determining the efficacy of the delay-and-add filter comprises the at least one processor comparing interference in the baseband signal with interference in the filtered signal.

26. The W-CDMA receiver of claim 25, further comprising a second combiner receiving the baseband and delayed signals as inputs, and providing a second filtered signal as an output.

27. The W-CDMA receiver of claim 25, wherein the processor communicatively receives as inputs the second filtered signal and the baseband signal.

28. A method of filtering a relatively narrowband interfering signal from a wideband received signal, the method comprising:

generating a delayed signal by delaying the received signal by a delay time calculated to produce a delay-and-add filter null at an expected frequency of the interfering signal; and

filtering the received signal by combining the received signal with the delayed signal to attenuate the interfering signal.

29. The method of claim 28, further comprising calculating the delay time based on a sampling frequency f_s of the received signal and the expected frequency of the interfering signal.

30. The method of claim 29, wherein calculating the delay time comprises determining a multiple of the sampling period $1/f_s$ that positions a filter null at an offset frequency substantially at the expected frequency of the interfering signal.

31. The method of claim 28, wherein the received signal is a baseband W-CDMA signal and the interfering signal is a baseband GSM signal, the method further comprising calculating the delay time to position the filter null substantially at the expected frequency of the baseband GSM signal.

32. The method of claim 28, wherein filtering the received signal comprises selectively filtering the received signal by selectively combining the received signal with the delayed signal.

33. The method of claim 32, further comprising selectively filtering the received signal based on at least one characteristic of the received signal.

34. The method of claim 33, wherein the received signal is a W-CDMA signal, and selectively filtering the received signal comprises filtering the received signal only if a spreading factor of the received signal is above a defined threshold.

35. The method of claim 32, further comprising selectively filtering the received signal based on determining whether filtering reduces interference in the received signal.

36. The method of claim 35, further comprising comparing interference in the received signal with interference in the filtered signal to determine whether filtering reduces interference in the received signal.

37. The method of claim 32, further comprising controlling a digital switch to implement selective filtering of the received signal, wherein the digital switch receives the delayed signal and selectively outputs the delayed signal to a combiner based on a controlled state of the digital switch, and wherein the combiner combines the received signal with the output from the digital switch.